Final report

Uptake and impacts of mobile apps for improving state effectiveness

International Growth Centre

Andrea di Miceli
Russell Toth

October 2018

DIRECTED BY
LSE
UNIVERSITY OF OXFORD

FUNDED BY
UKaid
from the British people

PIs: Andrea di Miceli and Russell Toth
October 31, 2018

Final Report: Uptake and Impacts of Mobile Apps for Improving State Effectiveness

Project Motivation and Objectives

New information technologies, and particularly the visual and audio medium supported by smartphones, have the potential to provide powerful tools to address gaps in state capacity to deliver health, educational and other services. Myanmar is experiencing an IT revolution, as a very recent mobile network rollout meant that the large majority of users, even those of lower socioeconomic status, leapt to smartphones. Meanwhile, Myanmar simultaneously suffers from significant gaps in state capacity after decades of military rule over a largely closed economy. Hence it is potentially an ideal setting to test such interventions.

We focus on a smartphone-based app in an area that a large recent literature in economics and other fields has shown could have significant lifelong returns: pre-natal health. In work most closely associated with the Nobel Prize winner Prof James Heckman of the University of Chicago, pre-natal health outcomes have been shown to be a strong predictor of adolescent and later-life education, health and economic performance outcomes, and hence are critical to building human capital that is critical for economic growth. Hence any intervention that can even marginally improve these outcomes, has the potential to have massive returns, especially an intervention such as a mobile application, which carries very low marginal cost, and is highly scalable. The app provides a broad range of health advice that is timed to the pregnancy cycle. Since smartphones do not have such reach elsewhere in the developing world, there is almost no evidence on end user-focused smartphone interventions. Qualitative research and analysis of key performance indicators of the app has shown that leveraging a Facebook-like interface and gamified, visually-appealing content leads to high user uptake and sustained engagement.

However, these initial indications of uptake and use do not answer the ultimate question that we care about: what is the impact of the app on pre-natal knowledge and behaviors, which are known to improve health *outcomes*? It is possible that the app is popular and gets used, but does not lead to significant improvements in real-world health behaviors and outcomes. Furthermore, it is possible that the app leads to unexpected outcomes, or perhaps even negative responses, as the new technologies interact with established knowledge, traditions, and institutions.

With the support of the IGC, and additional donors such as USAID and the Open Road alliance, this project provides critical new evidence on these issues. We conduct a series of pilot studies using the randomized control trial methodology to estimate the direct impacts of the app on maternal health knowledge and behaviors, and provide initial insights on mechanisms and behavioral responses, contributing new evidence on the potential of such technologies to bridge gaps in state capacity.

The Setting, the maymay app, and the Project Consortium

Pre-Natal Health and the IT expansion in Myanmar

Myanmar has some of the lowest pre-natal and maternal and child outcomes in the ASEAN region: according to the World Bank and the WHO, the infant mortality rate in Myanmar was 40 per 1000 live births in 2015,[1] while maternal mortality was 178 per 100,000 live births as of 2015.[2] Expanding health care infrastructure (including access to personnel), especially to rural and remote regions, will be an ongoing development challenge for Myanmar in the medium to long term, as in many developing countries. Hence there is significant gap in the capacity of the state to disseminate vital pre- and post-natal health information to citizens, including pregnant women. Reducing child mortality, and improving maternal health, are two of the Millennium Development Goals addressed by the intervention we study.

Given the recent massive expansion of mobile network coverage, mobile health technologies are a promising part of the solution to expand service delivery and improve healthcare outcomes. This is particularly true in Myanmar, where the relatively late mobile network rollout means that most users are leaping straight from no phone coverage at all, to smartphones with color screens that have the potential to provide a revolutionary platform to disseminate health information. As of August 2016, there were 45 million active SIM subscriptions in a population of 54 million and 60-80 percent of the subscriptions were for smart phones (Forbes Asia), from a base of less than 3 million SIM holders just 2 years earlier.

However, the most effective methods of deploying these technologies to public benefit and to augment public sector institutions remains largely unknown. Our project investigates whether an intervention customized to maximize the potential of the smartphone interface can help overcome gaps in state capacity to provide health information to lower-SES populations. Developing countries' bureaucracies are often severely budget constrained, so identifying the most effective (and cost-effective) ways of improving healthcare outcomes for underserved populations would provide a model for developing countries' governments to overcome gaps in capacity to better serve their citizens. Therefore, the scope of this project goes beyond a country-specific problem, addressing the question of whether technology can be used as a tool to overcome weak functioning of state institutions' provision of welfare and services.

The maymay app

The maymay app represents an exciting and innovative tool to potentially improve nutrition and health outcomes of mothers and children during the "first 1,000 days" period, by leveraging the smartphone interface through features such as gamification, notifications, and visually-appealing presentations of information. However, there is relatively little prior evidence to substantiate the impacts of this new intervention, especially in developing countries. While a quickly-growing literature on mobile health ("m-health") documents the impacts of various interventions around

---

[1]Mortality rate, infant (per 1000 live births). http://data.worldbank.org/indicator/SP.DYN.IMRT.IN
[2]Maternal Mortality in 1990-2015. "WHO, UNICEF, UNFPA, World Bank Group, and United Nations Population Division, Maternal Mortality Estimation Inter-Agency Group"
http://www.who.int/gho/maternal_health/countries/mmr.pdf

the world that leverage mobile phones, the vast majority of studies in the developing world are focused on interventions targeted at health *workers* (rather than consumers), or consumer applications utilizing the *feature* phone interface, often with mixed results. By contrast the maymay app leverages the unusually high smartphone penetration rate, including amongst poor households, in Myanmar. The dearth of prior, relevant, evidence called for a comprehensive and rigorous approach to impact assessment of maymay.

The intervention we are evaluating was designed by Koe Koe Tech, a Myanmar social enterprise that was founded in 2012. "maymay" was developed through financial support from the GSMA Connected Women program, with significant support from PSI in providing app content based on global best practice for maternal health.[3] maymay addresses key information needs of women throughout the pregnancy cycle. A new user is asked to enter her week of pregnancy and from there the app releases content and regular reminders guiding the user on everything from nutrition, to seeking medical services, to hygiene, to preparing for a healthy birth. The app is designed to maximize engagement, retention of knowledge, and motivation to action, using a Facebook-like user interface (Facebook is by far the most commonly-used app by the new internet user population in Myanmar) and "gamified" content such as knowledge quizzes.

Our own extensive pilot research with the app and analysis of rich data generated by users of the app (Key Performance Indicators, KPIs) provide evidence on users' performance and interest in the application. As of August 2016, that maymay app had over 35,000 users. Users' interest has been tracked using KPIs to measure whether users are engaged and absorbing information in the application. KPIs such as Quiz Points and Number of Lessons Completed suggest that nearly half of those who have the app loaded on their phone are actively engaged with the app and participate and respond to the gamified version of the app, a relatively high proportion compared to most other mobile apps where a 30-40% user rate is already very good. An interesting finding is that users are more responsive to interactive media to stay engaged with the app. We found that constantly reminding users through weekly reminder messages does not prompt users to be as responsive as having them engaged in quizzes and lessons. Quiz point results show that 28 percent (10,878 users) of 37,700 users participate in quizzes. Quizzes have 5 questions each; the average quiz participant has about 48 correct quiz responses accumulated, with the 95th percentile of 174 correct quiz responses. On average, 10.7 lessons are completed, with the 95th percentile of users having completed 38 lessons.

maymay Key Features and Message Content
Maymay app user will receive on average three messages per week that will differ depending on the month of pregnancy.

 The key features of maymay include:

1) Regular (i.e., three times per week) maternal and child health text messages with information targeted to the pregnancy week (or to the maturity of the child).
2) A doctor locator that allows the user to search for doctors by specialization and location, including Sun Clinic doctors. Sun Clinics are operated in Myanmar under the supervision

---

[3] See, e.g., http://www.koekoetech.com/maymay/ and http://www.gsma.com/mobilefordevelopment/ooredoo-myanmar-launches-maymay-a-maternal-health-app-for-women-on-3g-networks

of PSI.[4] The user will have to use GPS with internet access on their phone to find the nearest doctor from a SUN clinic.

3) Social networking: maymay users can enjoy live chat and social networking with other users of the app. Again, users must have GPS with internet access on their phone to enable the chat feature.

maymay app messages can be grouped in different categories, according to which our research team developed a set of questions and indicators for behavioral change. maymay categories can be grouped as follows:

1) Visits to clinics or health workers for antenatal care
2) Drugs and vaccinations
3) Knowledge about the status of the fetus and the evolution of the pregnancy
4) Nutrition habits
5) Hygiene habits
6) Smoking habits
7) Delivery
8) Birthing and Nursing practices
9) Daily life practices (personal or in relation to other household members)
10) Household economic practices

These indicators are summarized in more detail in the Appendix.

Relevant Academic Literature

First, our study relates to optimal information dissemination strategies. Bertrand et al. (2010) show how a change in advertising content can increase the take-up of microfinance loans, while Karlan et al. (2012) show that reminders to repay loans work only if they are coupled with some reference to personal obligation or reciprocity (mentioning loan officer name). Given the extensive evidence, we expect that the way information is disseminated would affect the decision to take-up the app.

Second, our study speaks to the nascent literature on the role of technology in augmenting state capacity and expanding political access. While there are emerging studies in this area, from tax collection[5] to voting[6] to aid distribution,[7] to the best of our knowledge ours is the first to

---

[4] The Sun network was launched by Population Services International in Myanmar in 2001. It is a franchise of licensed private sector general practitioners and community health care workers that serve low-income clients. There are approximately 3800 franchise members. Services include new-born and pediatric care, family planning, post-abortion care, and HIV, TB, STI, and malaria services. Currently there are more than 2000 active Sun Primary Health providers across the country that are offering basic health services; issuing referrals to other facilities, as necessary; selling health products, and implementing delivering behavior change communications.

[5] https://www.cmi.no/projects/1763-impact-of-technology-to-collect-taxes-in-ethiopia

[6] Fujiwara, T. 2015. "Voting Technology, Political Responsiveness and Infant Health: Evidence from Brazil" *Econometrica*, 83(2), 423–464.

[7] Muralidharan, K., P. Niehaus and S. Sukhtankar. Forthcoming. "Building State Capacity: Evidence from Biometric Smartcards in India." American Economic Review.

leverage smartphones as an information dissemination platform among a low-SES consumer user population.

Finally, our project studies the effectiveness of mobile health applications in improving health outcomes, in this case in Myanmar. Indeed, to the best of our knowledge, there does not exist a study in the economics literature that examines the effects of smartphone applications directly on the healthcare outcomes of newborn children and mothers, in setting with ubiquitous smartphone access amongst low-SES populations.

Main Project Activities and Findings

Our project involved conducting a number of pilots to evaluate the impact of the maymay app among pregnant women in urban and peri-urban Yangon. The pilots utilized the randomized control trial methodology: recruiting a sample of pregnant women around the 2nd trimester, and randomly selecting half to be offered the maymay app, with each participant having equal chance to be assigned to treatment or control. By "pilot" we mean that we carried out the studies as one would do for a full-scale study with data quality controls, ethical controls, etc., but with sample sizes that are not sufficiently large that they would be expected to yield statistically significant results for the main indicators, even for levels of effectiveness that would be considered meaningful. We focused on evaluating maymay along the dimensions it seeks to impact in the pre-natal period: primarily pre-natal knowledge around practices and behaviors such as nutrition, personal hygiene, consumption of pregnancy-related supplements such as iron pills and vitamins, and seeking support from the formal health system at relevant points in time. The pilots used baseline and follow-up surveys to measure knowledge and self-reported behaviors, along with basic demographic characteristics. The surveys were complemented by some administrative data generated by users of the maymay app. Some minimal constraints were put on the samples, such as that participants had to be over the age of 18, and have regular access to a smartphone. Ethical approval for the pilots was provided by the ethics committees at the University of Sydney and UCLA, and Myanmar's Department of Medical Research.

The project began by piloting the maymay app in the hospital with the largest number of births in Myanmar: Central Women's Hospital (CWH) in Ahlone Township in central Yangon. While there is a network of private hospitals in Yangon, mainly serving the upper tail of the income distribution, as a major public hospital we thought that CWH would provide access to a relatively diverse sample of pregnant women from across Yangon. This turned out to be correct in the sense of geographic diversity: at any given day and time, one can find women in the waiting room at CWH from dozens of townships around Yangon. Perhaps surprisingly, this is not even so heavily biased toward the townships in the vicinity of CWH. On the other hand, there was much less socio-economic diversity than expected, as women accessing CWH tend to have significant higher education levels and other indicators of socio-economic status than Yangon population averages. At the pilot scale of a couple hundred participants, we worked closely with CWH to recruit pregnant women who were otherwise spending time waiting for appointments in the CWH waiting area, randomizing an offer of the app at the end of the interaction. In successive pilots, baseline surveys were conducted in the waiting room, or as a follow-up at participants' homes. Given what we learned about the socio-economic status of the participants, it was perhaps not surprising that baseline levels of compliance with the main behaviors recommended by the maymay app were

relatively high, in some cases exceeding 90%. These levels of compliance suggested that a large-scale study would not be viable in this population, as it would be very difficult to detect treatment impacts. Hence while the pilots at CWH provided important insights on survey design, it was decided to seek to implement further piloting with a more socio-economically diverse population, in particular to reach women of lower socio-economic status, who might plausibly benefit the most from a new source of health information and guidance.

Hence further pilot work was carried out amongst a more socio-economically diverse population, close to a population representative sample of pregnant women from four of Yangon's peri-urban townships. From the baseline survey we learned that baseline knowledge levels of the main advice in the maymay app, and adherence to a number of recommended behaviors, was significantly lower in this more general population than the population at CWH, in some cases below 50%. This raised the possibility that the app might have the potential to generate significant improvements in health knowledge and behaviors. At the same time, it's important to re-emphasize that because we carried out pilot studies with sample sizes too small to have full statistical confidence in the results, we must interpret the findings with significant caution.

With this in mind, what we find is quite striking: on a number of dimensions the maymay app has negative impacts on pre-natal outcomes, in particular on a set knowledge questions pertaining to key health practices around nutrition and vaccination. For example, respondents from the treatment group are significantly *less* likely to know the correct timings and quantities for taking folic acid supplements or receiving tetanus vaccinations during pregnancy. Additionally, the average number of daily meals consumed by mothers in the treatment group is significantly lower than those in control, and treatment group mothers are less likely to reach the minimum acceptable daily meal frequency for pregnant women. Finally, treatment group members were less likely to receive any antenatal care over the course of their pregnancy. On the other hand, the app does seem to have positive impacts on a set of postnatal outcomes, including small but significantly positive effects on knowledge of optimal breastfeeding practices as well as the likelihood of having a skilled birth attendant present during delivery.

Implications, Next Steps, and Policy Impact

These pilot results raise a number of important questions. Are the findings "real," or might they be influenced by measurement error or otherwise biased? This seems unlikely, as measurement error would bias results toward zero, not to economically-meaningful effects. Another form of bias would be an effect whereby open-ended questions lead better-informed respondents to assess themselves with lower levels of health knowledge or practice (so maymay users end up looking worse off because they give themselves worse self-assessments), but this also is implausible since the main survey questions were quite precise and fact-based, rather than subjective.

If we believe the results are real, subjective to the caveats around statistical significance from any pilot study, why might an app have negative impacts on pre-natal outcomes? One possibility is that the app leads to an "information substitution" effect: the presence of the app leads users to seek or absorb less health information from other sources. Lending corroboration to the story is the fact that we see improvements in outcomes in both the treatment and control groups between baseline and follow-up, it is just that increases are *larger* for the control group (suggesting both

groups learn, it is just that the group without maymay learns more). Another possibility is that the app interacts in complex ways with intra-household relationships (e.g., with spouses, mothers, or mothers in law) — perhaps the app leads to enhanced emphasis on incorrect pre-natal advice. It is also possible that the app simply provides an "information overload" that confuses users, but again this kind of mechanism should bias results toward zero rather than pointing to effects in either direction. Why might impacts go in a different direction between pre-natal knowledge and behaviors, and those at birth? This is less clear. Perhaps the reinforcement of advice to seek a facilities-based birth is better aligned with other sources of information.

In any case, these initial findings raise new questions for future research. The pilot studies have been critical in helping us to refine our measurement strategy and research design, and inform the rollout of a larger-scale evaluation proposal that received funding from the UNOPS-LIFT consortium in 2018. Indeed, perhaps the greatest impact of the pilot work was in highlighting potential design issues with the maymay app. As our results were disseminated in the consortium of partners developing and disseminating the app, they directly responded by significantly simplifying the maymay content. Hence an important part of any future work will involve testing this new iteration of the app, along with more sharply identifying the mechanisms governing the interaction between users and this novel technology.

Appendix 1

SPECIFIC IMPACT INDICATORS

Since our goal is to detect behavioral change caused by the maymay application, our questionnaires target topics related to the content of the application. Overall there are eight distinct topics addressed by the app, these are respectively:

1) Visits to clinics or health workers for antenatal care
2) Drugs and vaccinations
3) Nutrition habits
4) Hygiene habits
5) Smoking habits
6) Delivery
7) Birthing and Nursing practices
8) Daily life practices (personal or in relation to other household members)

For each of the eight categories we designed a set of questions from which we can derive **key impact indicators** that are directly linked to the information delivered by maymay. Below we report a more detailed breakdown of the information within each category.

INDICATORS I - Visits to clinics or health workers for antenatal care
1) Number of times the woman visits health clinics or health workers during pregnancy in total
2) Number of times the woman visits health clinics or health workers during pregnancy due to an emergency situation
3) Number of times the woman visits health clinics or health workers after delivery both in total and in an emergency situation for herself or her children

INDICATORS II - Drugs and vaccinations
1) Number of women who seek iron syrup or iron tablets during pregnancy
2) Number of women who seek folic acid tablets during pregnancy
3) Number of women who seek treatment against malaria during pregnancy
4) Number of women who seek tetanus vaccination during pregnancy
5) Immunization choice for newly born children: number of women who have an official vaccination card; percentage of prescribed vaccination in the first 2 months after delivery actually seek by women for the sake of their children's health; number of times each vaccination has been sought by the woman in the first 2 months after delivery

INDICATORS III - Nutrition habits
1) Average number of meals and snacks per day for treated women with respect untreated women
2) Percentage of the prescribed types of food women regularly eat in a week
3) Number of women who regularly use iodine added salt

INDICATORS IV - Hygiene habits
1) Number of women who regularly wash their hands with soap
2) Number of women who properly dispose of newborn's stool

INDICATORS V - Smoking
1) Number of women who smoke cigarettes or make use of any type of tobacco
2) Average number of daily cigarettes women smoke

INDICATORS VI - Daily life practices (personal or in relation to other household members)
1) Number of women who know their blood group type and know someone among family members and friends with their same blood group type
2) Number of women who ask their friends and relatives for blood group type in the eventuality of a blood transfusion
3) Average daily time use for different activities: shopping, cooking, cleaning, working

INDICATORS VII - Delivery
1) Number of women giving birth at home that went to the clinic to look for birth kit for a clean and safe delivery
2) Number of women who delivered at the hospital/clinic.
3) Number of women who, immediately after birth, put the newborn directly on the bare skin of their chest

INDICATORS VIII - Nursing practices
1) Number of women who are still breastfeeding their child at the moment of the last follow-up
2) Number of times each woman breastfeeds per day
3) Number of women who have been giving to the newborn anything to drink other than breast milk

ADDITIONAL INDICATORS

In addition to the ones above, we also ask questions in order to understand the mechanism through which the maymay app actually triggered (or not) behavioural change in its users.

1) Ease of use of maymay: number of women who experienced issues in understanding or following maymay weekly messages
2) Constraints to the use of maymay: reasons for which women did not seek a specific drug or vaccination suggested by maymay. Similarly, we ask why women did not go to the clinic in case of emergency
3) Number of referrals that each respondent makes (friends or relatives)

Hypothesis 5 on the active usage of referred friends of the respondent will be tested through the adoption of the following indicators:
1) Number of women referred by the respondent who downloaded maymay app
2) Number of women referred by the respondent who actively use maymay app

The International Growth Centre
(IGC) aims to promote sustainable
growth in developing countries
by providing demand-led policy
advice based on frontier research.

Find out more about
our work on our website
www.theigc.org

For media or communications
enquiries, please contact
mail@theigc.org

Subscribe to our newsletter
and topic updates
www.theigc.org/newsletter

Follow us on Twitter
@the_igc

Contact us
International Growth Centre,
London School of Economic
and Political Science,
Houghton Street,
London WC2A 2AE

IGC

**International
Growth Centre**